

# PATENT ABSTRACTS OF JAPAN

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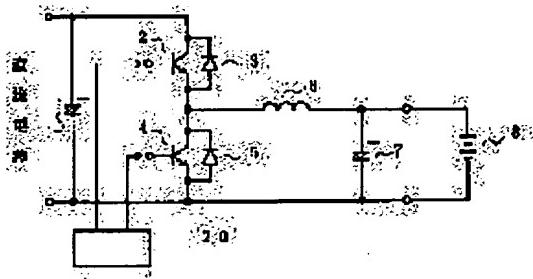
(21)Application number : 05-257366 (71)Applicant : FUJI ELECTRIC CO LTD  
 (22)Date of filing : 15.10.1993 (72)Inventor : YONEDA KAZUO

## (54) CONTROL OF CHARGING/DISCHARGING CIRCUIT OF STORAGE BATTERY AND CONTROLLER THEREOF

### (57)Abstract:

**PURPOSE:** To make the reactor of a step-up/step-down chopper compact by operating the step-up/step-down chopper at a high switching frequency at the time of charging of a storage battery and at a low switching frequency at the time of discharging.

**CONSTITUTION:** The ratio between the repeating frequency of the signal from a controller 20, which is imparted to the base of a transistor 2 performing ON/OFF operation in charging, and the repeating frequency of the signal from the controller, which is imparted to the base of a transistor 4 performing ON/ OFF operation in discharging, is determined with the built-in frequency divider in the controller 20 in the main circuit part of a step-up/step-down chopper. Thus, the purpose is achieved.



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The control approach of the charge-and-discharge circuit of the battery characterized by operating said step-down and step-up chopper in the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery on a switching frequency which is different, respectively at the time of charge of said battery, and discharge.

[Claim 2] The control approach of the charge-and-discharge circuit of the battery according to claim 1 characterized by operating a step-down and step-up chopper on a low switching frequency with a high switching frequency at the time of discharge at the time of charge of a battery.

[Claim 3] In the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery The oscillator which oscillates the switching frequency at the time of charge of a battery, and the 1st triangular wave converter which changes the output of said oscillator into a triangular wave, The 1st comparator which compares said the 1st output and charge control signal of a triangular wave converter, and operates, The controller of the charge-and-discharge circuit of the battery characterized by coming to have the 2nd comparator which compares the output and discharge control signal of the counting-down circuit which carries out dividing of the output of said oscillator, the 2nd triangular wave converter which changes the output of said counting-down circuit into a triangular wave, and said 2nd triangular wave converter, and operates.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

[Industrial Application] This invention relates to the control approach of the charge-and-discharge circuit of the battery at the time of having a battery, for example, constituting no cutting-off-the electric current-ization of an adjustable electrical potential difference and a variable frequency (VVVF) inverter, and its controller.

**[0002]**

[Description of the Prior Art] What is indicated by JP,5-122865,A is known as a charge-and-discharge circuit of the conventional battery. The charge-and-discharge circuit of this battery is explained based on the circuit diagram of drawing 4. In drawing 4, the capacitor by which 1 is connected to DC power supply and juxtaposition, the capacitor by which diode and 6 are connected to a reactor and 7 is connected [ 2 and 4 ] to a battery 8 and juxtaposition for a transistor, and 3 and 5, and 10 are controllers which control the base of transistors 2 and 4, and the main circuit section of a step-down and step-up chopper consists of 1-7.

[0003] At the time of charge of a battery 8, a transistor 4 is made off, in order to make a transistor 2 turn on and off, an on-off signal is given to the base of a transistor 2, at the time of discharge of a battery 8, a transistor 2 is made off, and in order to make a transistor 4 turn on and off, he is trying to give an on-off signal to the base of a transistor 4 from a controller 10. In that case, the repeat frequency of the on-off signal to the base of a transistor 2 or a transistor 4, i.e., the switching frequency of a step-down and step-up chopper, is fixed, and the request is controlled by adjusting an on-off ratio.

**[0004]**

[Problem(s) to be Solved by the Invention] In the charge-and-discharge circuit of the conventional battery, pulsation (ripple) of said charging current becomes large, since it is not desirable for a battery, the inductance value of said reactor is enlarged and the current of said reactor is usually made not intermittent [ compared with the time of discharge, / since the charging current is small, the current of the reactor (sign 6 reference of drawing 4) of the main circuit section of a step-down and step-up chopper is intermittent consequently ] at the time of charge.

[0005] Therefore, said reactor was enlarged, and since the inductance value was large, when sudden change occurred for the load by the side of DC power supply at the time of discharge, there was a problem that fluctuation of the output voltage by the side of DC power supply became large. Moreover, in order to control fluctuation of the output voltage by the side of said DC power supply, there was also a problem that the capacity of the capacitor by the side of DC power supply (sign 1 reference of drawing 4) became large.

[0006] The technical problem of this invention miniaturizes said reactor, and is to control fluctuation of the output voltage at the time of sudden change of the load by the side of DC power supply.

**[0007]**

[Means for Solving the Problem] In order to solve this technical problem, in this invention, in the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery, it is a switching frequency high at the time of charge of a battery, and a step-down and step-up chopper is operated on a low switching frequency at the time of discharge.

[0008] Moreover, the oscillator with which the controller of the charge-and-discharge circuit of a battery oscillates the switching frequency at the time of charge of a battery, The 1st comparator which compares the output and charge control signal of the 1st triangular wave converter which changes the output of said oscillator

into a triangular wave, and said 1st triangular wave converter, and operates, It has the 2nd comparator which compares the output and discharge control signal of the counting-down circuit which carries out dividing of the output of said oscillator, the 2nd triangular wave converter which changes the output of said counting-down circuit into a triangular wave, and said 2nd triangular wave converter, and operates.

[0009]

[Function] In the charge-and-discharge circuit of the battery which has the bidirectional step-down and step-up chopper which combines the function to charge a battery, and the function which discharges from a battery at the time of charge of a battery, on a high switching frequency In operating a step-down and step-up chopper on a low switching frequency at the time of discharge, at the time of charge The current of the reactor (sign 6 reference of drawing 4 ) of the main circuit section of a step-down and step-up chopper continues.

Consequently, since pulsation (ripple) of said charging current becomes small, serves as the suitable charging current for a battery and can make the inductance value of said reactor small at the time of discharge, even if the load by the side of DC power supply changes suddenly, fluctuation of the output voltage by the side of DC power supply can be suppressed small.

[0010]

[Example] The circuit diagram of the example of this invention is shown in drawing 1 . In drawing 1 R> 1, the same sign is given to what has the same function as drawing 4 , explanation is omitted, and it explains focusing on the thing of a different function from drawing 4 . That is, in drawing 1 , the controller of the former [ controller / 20 ] is equipped with different circuitry, and is as the detail being shown in drawing 2 .

[0011] The oscillator 21 which drawing 2 is the circuit diagram of the controller of the charge-and-discharge circuit of the battery by this invention, and oscillates the switching frequency at the time of charge of a battery, The comparator 23 which compares with the output and charge control signal of the triangular wave converter 22 the triangular wave converter 22 which changes the output of an oscillator 21 into a triangular wave, and operates, It consists of comparators 26 which compare with the output and discharge control signal of the triangular wave converter 25 the counting-down circuit 24 which carries out dividing of the output of an oscillator 21, and the triangular wave converter 25 which changes the output of a counting-down circuit 24 into a triangular wave, and operate.

[0012] The wave form chart of drawing 3 explains actuation of the controller of the charge-and-discharge circuit of drawing 2 , referring to drawing 1 and the name of drawing 2 , and a sign. In this drawing, at the time of charge of the battery 8 shown in (\*\*) of drawing 3 , the output of a comparator 23, i.e., the base signal of a transistor 2, repeats turning on and off like (\*\*) of drawing 3 , the output of a comparator 26, i.e., the base signal of a transistor 4, continues an OFF state like (Ha) of drawing 3 , and the on-off ratio at this time is adjusted by the comparator 23 by the level of a charge control signal and the output of the triangular wave converter 22 which are shown in drawing 2 . Moreover, at the time of discharge of the battery 8 shown in (\*\*) of drawing 3 , the output of a comparator 26, i.e., the base signal of a transistor 4, repeats turning on and off like (Ha) of drawing 3 , the output of a comparator 23, i.e., the base signal of a transistor 2, continues an OFF state like (b) of drawing 3 , and the on-off ratio at this time is adjusted by the comparator 26 by the level of a discharge control signal and the output of the triangular wave converter 25 which are shown in drawing 2 . The ratio of the repeat frequency of turning on and off of (\*\*) of drawing 3 and the repeat frequency of turning on and off of (Ha) of drawing 3 is determined by the counting-down circuit 24.

[0013] In drawing 2 , although the repeat frequency of turning on and off at the time of discharge is decided with the oscillator 21 and the counting-down circuit 24 which carries out dividing of the output of an oscillator 21, it is also possible to constitute the function equivalent to an oscillator 21 and a counting-down circuit 24 from an oscillator with another oscillator 21. Moreover, as for all, the bipolar transistor which has self-extinction of arc capacity, a field-effect transistor, an insulated gate transistor (IGBT), etc. are usable as a switching semiconductor device of the main circuit section of a step-down and step-up chopper.

[0014]

[Effect of the Invention] By this invention, by increasing the switching frequency of the step-down and step-up chopper for example, at the time of charge 5 times of the switching frequency of the step-down and step-up chopper at the time of discharge, the inductance value of a reactor can be set to about 1/5 compared with the former, the miniaturization of a reactor can be measured, and a miniaturization and cost cut of a battery of a charge-and-discharge circuit can be performed.

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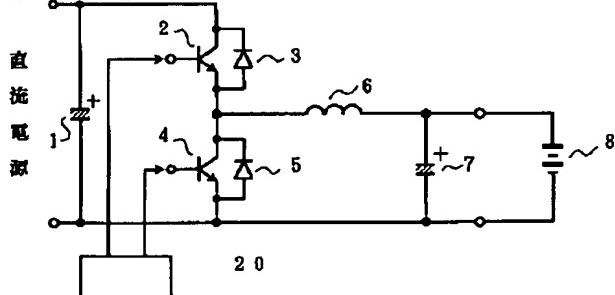
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## DRAWINGS

## [Drawing 1]

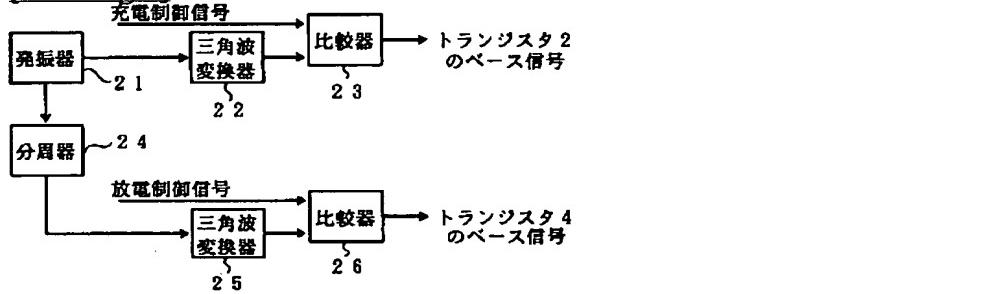


1 : コンデンサ, 2 : パワートランジスタ, 3 : ダイオード

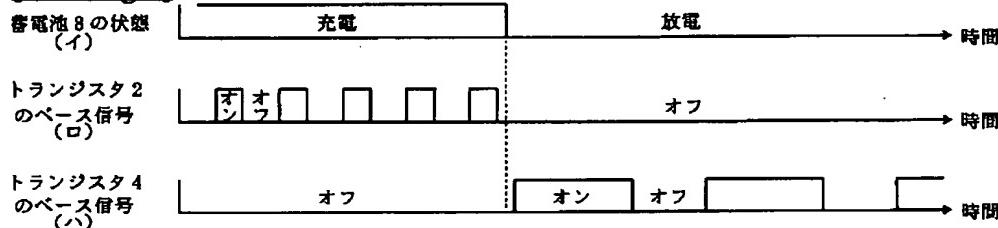
4 : パワートランジスタ, 5 : ダイオード, 6 : リアクトル

7 : コンデンサ, 8 : 電池, 20 : 制御器

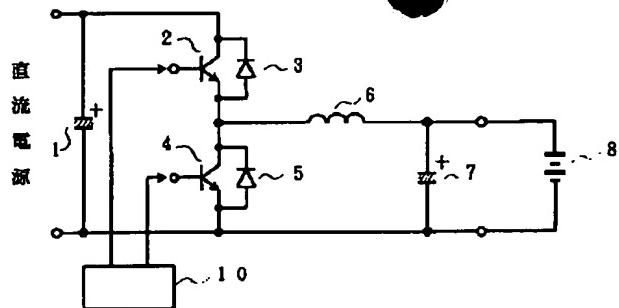
## [Drawing 2]



## [Drawing 3]



## [Drawing 4]



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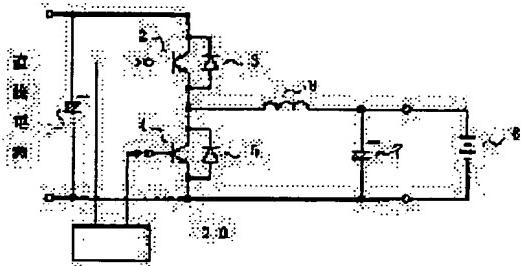
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### (57)Abstract:

PURPOSE: To make the reactor of a step-up/step-down chopper compact by operating the step-up/step-clown chopper at a high switching frequency at the time of charging of a storage battery and at a low switching frequency at the time of discharging.

CONSTITUTION: The ratio between the repeating frequency of the signal from a controller 20, which is imparted to the base of a transistor 2 performing ON/OFF operation in charging, and the repeating frequency of the signal from the controller, which is imparted to the base of a transistor 4 performing ON/OFF operation in discharging, is determined with the built-in frequency divider in the controller 20 in the main circuit part of a step-up/step-clown chopper. Thus, the purpose is achieved.



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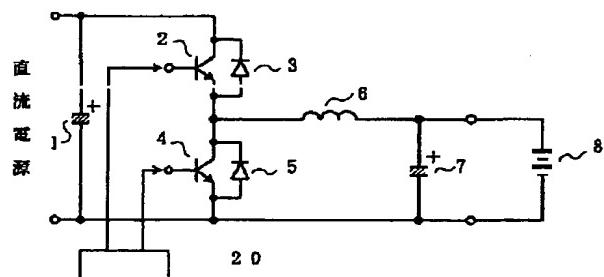
(74)代理人 弁理士 山口 厳

(54)【発明の名称】蓄電池の充放電回路の制御方法およびその制御器

(57)【要約】

【目的】蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チャップを動作させることで、前記昇降圧チャップのリアクトルを小型化する。

【構成】昇降圧チャップの主回路部において、充電時にオン・オフ動作するトランジスタ2のベースに与える制御器20からの信号の繰り返し周波数と、放電時にオン・オフ動作をするトランジスタ4のベースに制御器20からの信号の繰り返し周波数の比率を制御器20に内蔵する分周器で決めることで、上記目的を達成する構成。



1:コンデンサ, 2:トランジスタ, 3:ダイオード

4:トランジスタ, 5:ダイオード, 6:リアクトル

7:コンデンサ, 8:蓄電池, 20:制御器

## 【特許請求の範囲】

【請求項1】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、前記蓄電池の充電時と、放電時にそれぞれ異なるスイッチング周波数で前記昇降圧チョッパを動作させることを特徴とする蓄電池の充放電回路の制御方法。

【請求項2】蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させることを特徴とする請求項1に記載の蓄電池の充放電回路の制御方法。

【請求項3】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時のスイッチング周波数を発振する発振器と、前記発振器の出力を三角波に変換する第1の三角波変換器と、前記第1の三角波変換器の出力と充電制御信号とを比較して動作する第1の比較器と、前記発振器の出力を分周する分周器と、前記分周器の出力を三角波に変換する第2の三角波変換器と、前記第2の三角波変換器の出力と放電制御信号とを比較して動作する第2の比較器とを備えてなることを特徴とする蓄電池の充放電回路の制御器。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】この発明は、蓄電池を備えて、例えば、可変電圧・可変周波数(VVVVF)インバータの無停電化を構成する際の蓄電池の充放電回路の制御方法およびその制御器に関する。

## 【0002】

【従来の技術】従来の蓄電池の充放電回路として、例えば特開平5-122865号公報に開示されているものが知られている。この蓄電池の充放電回路を図4の回路図に基づいて説明する。図4において、1は直流電源と並列に接続されるコンデンサ、2, 4はトランジスタ、3, 5はダイオード、6はリクトル、7は蓄電池8と並列に接続されるコンデンサ、10はトランジスタ2, 4のベースを制御する制御器であり、1～7で昇降圧チョッパの主回路部が構成されている。

【0003】制御器10より、蓄電池8の充電時にはトランジスタ4をオフとし、トランジスタ2をオン・オフさせるためにトランジスタ2のベースにオン・オフ信号を与え、蓄電池8の放電時にはトランジスタ2をオフとし、トランジスタ4をオン・オフさせるためにトランジスタ4のベースにオン・オフ信号を与えるようにしている。その際、トランジスタ2またはトランジスタ4のベースへのオン・オフ信号の繰り返し周波数すなわち昇降圧チョッパのスイッチング周波数は一定で、オン・オフ比を調節することで所望の制御を行っている。

## 【0004】

【発明が解決しようとする課題】従来の蓄電池の充放電

回路では、充電時には、放電時に比べて、充電電流が小さいため昇降圧チョッパの主回路部のリクトル(図4の符号6参照)の電流が断続し、その結果、前記充電電流の脈動(リブル)が大きくなり蓄電池にとって好ましくないため、通常、前記リクトルのインダクタンス値を大きくして前記リクトルの電流を断続しないようにしている。

【0005】そのため、前記リクトルが大型化し、インダクタンス値が大きいため、放電時に直流電源側の負荷に急変が発生すると直流電源側の出力電圧の変動が大きくなるという問題があった。また、前記直流電源側の出力電圧の変動を抑制するため直流電源側のコンデンサ(図4の符号1参照)の容量が大きくなるという問題もあった。

【0006】この発明の課題は、前記リクトルを小型化し、直流電源側の負荷の急変時の出力電圧の変動を抑制することにある。

## 【0007】

【課題を解決するための手段】この課題を解決するため20に、この発明では、蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させるものである。

【0008】また、蓄電池の充放電回路の制御器は、蓄電池の充電時のスイッチング周波数を発振する発振器と、前記発振器の出力を三角波に変換する第1の三角波変換器と、前記第1の三角波変換器の出力と充電制御信号とを比較して動作する第1の比較器と、前記発振器の出力を分周する分周器と、前記分周器の出力を三角波に変換する第2の三角波変換器と、前記第2の三角波変換器の出力と放電制御信号とを比較して動作する第2の比較器とを備えるものである。

## 【0009】

【作用】蓄電池に充電する機能と、蓄電池から放電する機能とを兼ね備えた双方向の昇降圧チョッパを有する蓄電池の充放電回路において、蓄電池の充電時には高いスイッチング周波数で、放電時には低いスイッチング周波数で昇降圧チョッパを動作させることで、充電時には、昇降圧チョッパの主回路部のリクトル(図4の符号6参照)の電流が連続し、その結果、前記充電電流の脈動(リブル)が小さくなり蓄電池にとって好適な充電電流となり、放電時には前記リクトルのインダクタンス値を小さくできるため、直流電源側の負荷が急変しても直流電源側の出力電圧の変動を小さく抑えられる。

## 【0010】

【実施例】図1にこの発明の実施例の回路図を示す。図1において、図4と同一機能を有するものには同一符号50を付して説明を省略し、図4と異なる機能のものを中心

に説明する。すなわち図1において、制御器20は従来の制御器とは異なった回路構成を備えており、その詳細は図2に示す通りである。

【0011】図2はこの発明による蓄電池の充放電回路の制御器の回路図であり、蓄電池の充電時のスイッチング周波数を発振する発振器21と、発振器21の出力を三角波に変換する三角波変換器22と、三角波変換器22の出力と充電制御信号とを比較して動作する比較器23と、発振器21の出力を分周する分周器24と、分周器24の出力を三角波に変換する三角波変換器25と、三角波変換器25の出力と放電制御信号とを比較して動作する比較器26とで構成されている。

【0012】図2の充放電回路の制御器の動作を、図1および図2の名称、符号を参照しつつ、図3の波形図により説明する。同図において、図3の(イ)に示す蓄電池8の充電時には比較器23の出力すなわちトランジスタ2のベース信号は図3の(ロ)の如くオン・オフを繰り返し、比較器26の出力すなわちトランジスタ4のベース信号は図3の(ハ)の如くオフ状態を続け、このときのオン・オフ比は図2に示す充電制御信号のレベルと三角波変換器22の出力とにより比較器23で調整される。また、図3の(イ)に示す蓄電池8の放電時には比較器26の出力すなわちトランジスタ4のベース信号は図3の(ハ)の如くオン・オフを繰り返し、比較器23の出力すなわちトランジスタ2のベース信号は図3の(ロ)の如くオフ状態を続け、このときのオン・オフ比は図2に示す放電制御信号のレベルと三角波変換器25の出力とにより比較器26で調整される。図3の(ロ)のオン・オフの繰り返し周波数と、図3の(ハ)のオン・オフの繰り返し周波数との比率は分周器24で決定される。

【0013】図2においては、発振器21と、発振器2

1の出力を分周する分周器24とで放電時のオン・オフの繰り返し周波数を決めておりが、発振器21と分周器24に相当する機能を発振器21とは別の発振器で構成することも可能である。また、昇降圧チョッパの主回路部のスイッチング半導体素子として、自己消弧能力を有するバイポーラトランジスタ、電界効果トランジスタ、絶縁ゲートトランジスタ(IGBT)等いずれも使用可能である。

#### 【0014】

10 【発明の効果】この発明により、例えば、充電時の昇降圧チョッパのスイッチング周波数を放電時の昇降圧チョッパのスイッチング周波数の5倍にすることにより、リアクトルのインダクタンス値を従来に比べて約5分の1にすることができる、リアクトルの小型化が計れ、蓄電池の充放電回路の小型化とコストダウンができる。

#### 【図面の簡単な説明】

【図1】この発明の実施例を示す回路図

【図2】図1の制御器を示す回路図

【図3】図2の動作を説明する波形図

20 【図4】従来例を示す回路図

#### 【符号の説明】

1, 7 コンデンサ

2, 4 パソコン

3, 5 ダイオード

6 リアクトル

8 蓄電池

10, 20 制御器

21 発振器

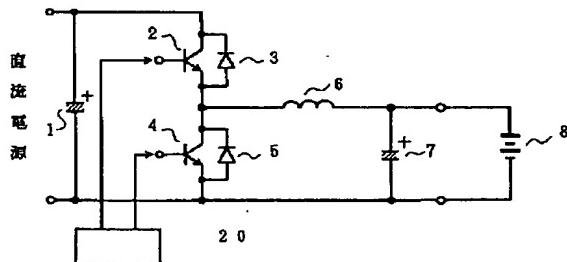
22, 25 三角波変換器

23, 26 比較器

24 分周器

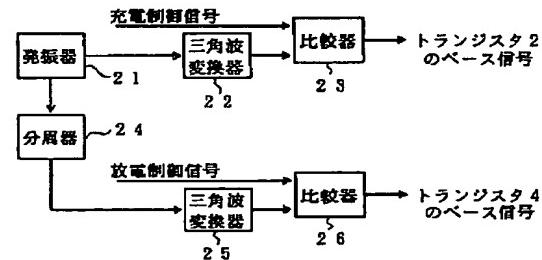
30

【図1】

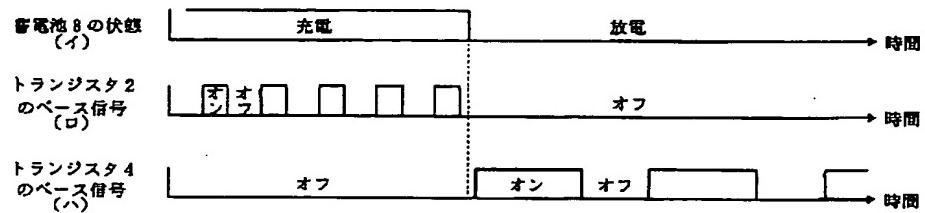


- 1 : コンデンサ
- 2 : パソコン
- 3 : ダイオード
- 4 : パソコン
- 5 : ダイオード
- 6 : リアクトル
- 7 : コンデンサ
- 8 : 蓄電池
- 20 : 制御器

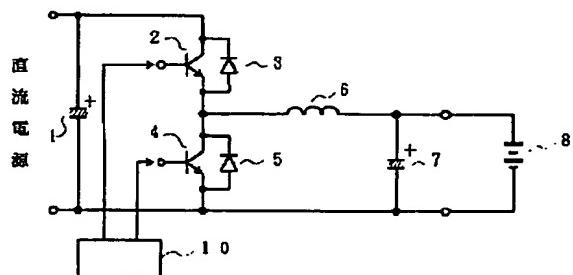
【図2】



【図3】



【図4】



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